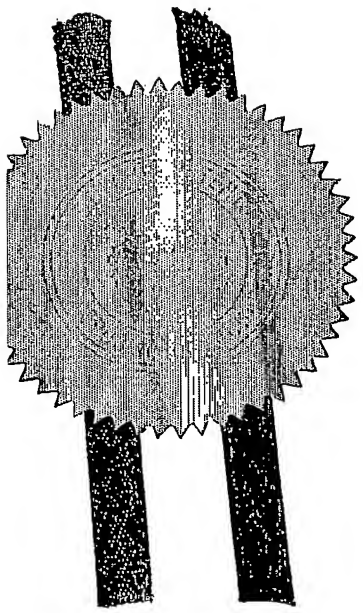
PCT/SG03/00065

REGISTRY OF PATENTS
SINGAPORE

This is to certify that the annexed is a true copy of the following Singapore patent application as filed in this Registry.

Date of Filing	:	30 MAY 2002
Application number	:	200203246-4
Applicants	:	HYDROBALL TECHNICS PTE LTD
Title of Invention	:	A CLEANING SYSTEM

I further certify that the annexed documents are not, as yet, open to public inspection.



Chig Kam Tack (Mr)
Assistant Registrar
for REGISTRAR OF PATENTS
SINGAPORE

10 Apr 2003

ACTION

PATENTS FORM 1
Patents Act
(Cap. 221)
Patents Rules
Rule 19

INTELLECTUAL PROPERTY OFFICE OF SINGAPORE

101101

REQUEST FOR THE GRANT OF A PATENT UNDER SECTION 25

* denotes mandatory fields

1. YOUR REFERENCE* SP5054

2. TITLE OF INVENTION* A CLEANING SYSTEM

3. DETAILS OF APPLICANT(S)* (see note 3) Number of applicant(s): 1

NS-01C
6/5

(A) Name: Hydroball Technics Pte Ltd

Address: Blk 1 Rochor Rd #02-506 Rochor Centre
Singapore 180001

State: | Country: SG

[X] For corporate applicant [ ] For individual applicant

State of incorporation: | State of residency:

Country of incorporation: SG | Country of residency:

[ ] For others (please specify in the box provided below)

02 MAY 30 15:57

(B) Name:

Address:

State: | Country:

200203246-4

☐ For corporate applicant ☐ For individual applicant

State of incorporation | State of residency

Country of incorporation | Country of residency

☐ For others (please specify in the box provided below)

(C) Name

Address

State | Country

☐ For corporate applicant ☐ For individual applicant

State of incorporation | State of residency

Country of incorporation | Country of residency

☐ For others (please specify in the box provided below)

☐ Further applicants are to be indicated on continuation sheet 1

4. DECLARATION OF PRIORITY (see note 5)

A. Country/country designated

File number | Filing Date DD MM YYYY

B. Country/country designated

File number | Filing Date DD MM YYYY

☐ Further details are to be indicated on continuation sheet 6

5. INVENTOR(S)* (see note 6)

A. The applicant(s) is/are the sole/joint inventor(s) Yes ☐ No ☒

200203246-4

30 MAY 2007

B. A statement on Patents Form 8 is/will be furnished Yes [X] No [ ]

6. CLAIMING AN EARLIER FILING DATE UNDER (see note 7)

[ ] section 20(3) [ ] section 26(6) [ ] section 47(4)

Patent application number [ ]

DD MM YYYY

Filing Date [ ]

Please mark with a cross in the relevant checkbox provided below
(Note: Only one checkbox may be crossed.)

[ ] Proceedings under rule 27(1)(a)

DD MM YYYY

Date on which the earlier application was amended [ ]

[ ] Proceedings under rule 27(1)(b)

7. SECTION 14(4)(C) REQUIREMENTS (see note 8)

Invention has been displayed at an international exhibition. Yes [ ] No [X]

8. SECTION 114 REQUIREMENTS (see note 9)

The invention relates to and/or used a micro-organism deposited for the purposes of disclosure in accordance with section 114 with a depository authority under the Budapest Treaty.

Yes [ ] No [X]

9. CHECKLIST*

(A) The application consists of the following number of sheets

i.	Request	5	Sheets
ii.	Description	11	Sheets
iii.	Claim(s)	3	Sheets
iv.	Drawing(s)	6	Sheets
v.	Abstract (Note: The figure of the drawing, if any, should accompany the abstract)	1	Sheets
Total number of sheets		26	Sheets

(B) The application as filed is accompanied by:

[ ] Priority document(s) [ ] Translation of priority document(s)

30 MAY 2002

200203246-4

[X] Statement of inventorship & right to grant

[ ] International exhibition certificate

10. DETAILS OF AGENT (see notes 10, 11 and 12)

Name

Firm LLOYD WISE

11. ADDRESS FOR SERVICE IN SINGAPORE* (see note 10)

Block/Hse No. | Level No. | Unit No./PO Box

Street Name P.O BOX 636

Building Name TANJONG PAGAR POST OFFICE

Postal Code 910816

12. NAME, SIGNATURE AND DECLARATION (WHERE APPROPRIATE) OF APPLICANT OR AGENT* (see note 12)
(Note: Please cross the box below where appropriate.)

[X] I, the undersigned, do hereby declare that I have been duly authorised to act as representative, for the purposes of this application, on behalf of the applicant(s) named in paragraph 3 herein.

Lloyd Wise

Name and Signature LLOYD WISE

DD MM YYYY

30 05 2002

Our Ref: SP5054

200203246-4

30 MAY 2002

NOTES:

1. This form when completed, should be brought or sent to the Registry of Patents together with the rest of the application. Please note that the filing fee should be furnished within the period prescribed.

2. The relevant checkboxes as indicated in bold should be marked with a cross where applicable.

3. Enter the name and address of each applicant in the spaces provided in paragraph 3.
   Where the applicant is an individual
   - Names of individuals should be indicated in full and the surname or family name should be underlined.
   -The address of each individual should also be furnished in the space provided.
   - The checkbox for "For individual applicant" should be marked with a cross.

   Where the applicant is a body corporate
   - Bodies corporate should be designated by their corporate name and country of incorporation and, where appropriate, the state of incorporation within that country should be entered where provided.
   - The address of the body corporate should also be furnished in the space provided.
   - The checkbox for "For corporate applicant" should be marked with a cross.

   Where the applicant is a partnership
   - The details of all partners must be provided. The name of each partner should be indicated in full and the surname or family name should be underlined.
   - The address of each partner should also be furnished in the space provided.
   - The checkbox for "For others" should be marked with a cross and the name and address of the partnership should be indicated in the box provided.

4. In the field for "Country", please refer to the standard list of country codes made available by the Registry of Patents and enter the country code corresponding to the country in question.

5. The declaration of priority in paragraph 4 should state the date of the previous filing, the country in which it was made, and indicate the file number, if available. Where the application relied upon in an International Application or a regional patent application e.g. European patent application, one of the countries designated in that application [being one falling under section 17 of the Patents Act] should be identified and the country should be entered in the space provided.

6. Where the applicant or applicants is/are the sole inventor or the joint inventors, paragraph 5 should be completed by marking with a cross the 'YES' checkbox in the declaration (A) and the 'NO' checkbox in the alternative statement (B). Where this is not the case, the 'NO' checkbox in declaration (A) should be marked with a cross and a statement will be required to be filed on Patents Form 8.

7. When an application is made by virtue of section 20(3), 26(6) or 47(4), the appropriate section should be identified in paragraph 6 and the number of the earlier application or any patent granted thereon identified. Applicants proceeding under section 26(6) should identify which provision in rule 27 they are proceeding under. If the applicants are proceeding under rule 27(1)(a), they should also indicate the date on which the earlier application was amended.

8. Where the applicant wishes an earlier disclosure of the invention by him at an International Exhibition to be disregarded in accordance with section 14(4)(c), then the 'YES' checkbox at paragraph 7 should be marked with a cross. Otherwise, the 'NO' checkbox should be marked with a cross.

9. Where in disclosing the invention the application refers to one or more micro-organisms deposited with a depository authority under the Budapest Treaty, then the 'YES' checkbox at paragraph 8 should be marked with a cross. Otherwise, the 'NO' checkbox should be marked with a cross. Attention is also drawn to the Fourth Schedule of the Patents Rules.

10. Where an agent is appointed, the fields for "DETAILS OF AGENT" and "ADDRESS FOR SERVICE IN SINGAPORE" should be completed and they should be the same as those found in the corresponding Patents Form 41. In the event where no agent is appointed, the field for "ADDRESS FOR SERVICE IN SINGAPORE" should be completed, leaving the field for "DETAILS OF AGENT" blank.

11. In the event where an individual is appointed as an agent, the sub-field "Name" under "DETAILS OF AGENT" must be completed by entering the full name of the individual. The sub-field "Firm" may be left blank. In the event where a partnership/body corporate is appointed as an agent, the sub-field "Firm" under "DETAILS OF AGENT" must be completed by entering the name of the partnership/body corporate. The sub-field "Name" may be left blank.

12. Attention is drawn to sections 104 and 105 of the Patents Act, rules 90 and 105 of the Patents Rules, and the Patents (Patent Agents) Rules 2001.

13. Applicants resident in Singapore are reminded that if the Registry of Patents considers that an application contains information the publication of which might be prejudicial to the defence of Singapore or the safety of the public, it may prohibit or restrict its publication or communication. Any person resident in Singapore and wishing to apply for patent protection in other countries must first obtain permission from the Singapore Registry of Patents unless they have already applied for a patent for the same invention in Singapore. In the latter case, no application should be made overseas until at least 2 months after the application has been filed in Singapore, and unless no directions had been issued under section 33 by the Registrar or such directions have been revoked. Attention is drawn to sections 33 and 34 of the Patents Act.

14. If the space provided in the patents form is not enough, the additional information should be entered in the relevant continuation sheet. Please note that the continuation sheets need not be filed with the Registry of Patents if they are not used.

A Cleaning System

Background and Field of the Invention

This invention relates to a cleaning system which uses mobile cleaning elements for cleaning the inside of tubing.

A heat distributing system typically has a condenser unit which includes tubing to conduct fluids. There have been proposed different ways of cleaning the inside of such tubing to prevent the build up of dirt or other unwanted deposits inside the tubing as the fluids travel through the tubing.

One proposed way is the use of cleaning balls made of rubber or spongy material which have a diameter slightly larger than the tubing so that when they travel through the tubing with the fluid, the balls are compressed. In this way, the balls are made to rub against the walls of the tubing so as to keep the walls clean and substantially free from deposits. Generally, the balls and the fluid are passed through the tubing, in the direction of the fluid flow, from the upstream side to the downstream side of the tubing. The balls are then separated from the fluid at the downstream side and then recirculated back to the upstream side of the tubing. A pump, such as that described in patent document US6,070,652, typically provides the means to recirculate the balls. However, a disadvantage of using a pump to recirculate the balls is that the pump is susceptible to malfunctioning and such a system usually requires considerable downtime for maintenance and repair.

To overcome the above disadvantage, there has been proposed a cleaning system that does not use a pump to recirculate the balls, an example of which is described in patent document US 5,592,990. In this prior art, the recirculating means comprises a housing disposed between the upstream and downstream side of the tubing. The housing includes an apertured partition which divides the housing into an upper compartment and a lower compartment. When the balls are recirculated and collected by this housing, the partition permits the fluid to pass through to the lower compartment while keeping the balls in the upper compartment. The housing further comprises a first passageway which connects one end of the upper compartment to the downstream side of the tubing, a second and third passageway connecting the other end of the upper compartment to a first and second section in the upstream side of the tubing such that the second section of the tubing has a slightly lower pressure compared to the pressure at the first section but higher than that at the downstream side of the tubing. The housing also comprises a fourth passageway connecting the lower compartment to a source of lower pressure than that in any of three other passageways. The cleaning system disclosed in this prior art also has a plurality of valves arranged to control the fluid flow along the different passageways described above. A disadvantage of this prior art is the complexity of the design which requires a sequence of actions to close and open the plurality of valves to recirculate the balls. In addition, to draw the balls into the housing, the valve disposed at the fourth passageway must be opened and this may discharge the fluid. As a result, the fluid is wasted each time the balls are recirculated and the cost of maintaining such a system may be

relatively expensive.

It is an object of this invention to provide a cleaning system which alleviates at least one of the disadvantages of the prior art.

Summary of the invention

The invention, in general terms, is to provide a system for cleaning tubing connected to an inlet pipe and an outlet pipe, using cleaning elements, such as balls, which are recirculated by controlling two valves. A constriction is formed at the inlet pipe so as to create a point of low pressure with respect to the outlet pipe to recirculate the balls.

According to a first aspect of the present invention, there is provided a cleaning system for cleaning tubing used for conducting a fluid therethrough, the tubing being connected to an inlet pipe and an outlet pipe, the system comprising

a plurality of cleaning elements for circulating with the fluid through the tubing;

a separator disposed at the outlet pipe and arranged to separate the cleaning elements from the fluid;

recirculating means arranged to selectively transfer the plurality of cleaning elements from the outlet pipe to the inlet pipe,

wherein the inlet pipe includes a constriction having an inlet coupled to the recirculating means such that the pressure at the constriction of the inlet pipe is lower than that at the outlet pipe.

An advantage of the described embodiment of the invention is that the different pressures at the inlet pipe and the outlet pipe create a suction force which provides an easy and cost efficient way of circulating the cleaning elements for cleaning the tubing. Such a system is also environmental friendly since there is no wastage of the fluid.

The invention is particularly useful for cleaning the tubing of a heat-exchanger used in a condenser, and the invention is therefore described below with respect to such an application.

Brief Description of the Drawings

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 illustrates a cleaning system according to the invention which comprises a housing to collect the balls at rest, a constriction member and a separator;

Figure 1a illustrates a cross-sectional view of the constriction member used in the cleaning system of Figure 1;

Figure 2 illustrates the cleaning system of Figure 1 when the cleaning balls are caused to circulate through the tubing;

Figure 3 illustrates the situation when the balls have passed through the tubing and are trapped by the separator of Figure 1;

Figure 4 illustrates a cross-sectional view of the separator of Figure 3 which traps the cleaning balls after they have passed through the tubing; and

Figure 5 shows a detailed view of the separator of Figure 4.

Detailed Description of the Preferred Embodiment

Figure 1 illustrates a cleaning system used to clean tubing 9 in a condenser 8. The tubing 9 is in the form of a plurality of parallel spaced tubes which are connected to an inlet pipe 6 and an outlet pipe 10. A cooling fluid such as water is passed through the tubing 9 in order to condense another fluid, such as steam or a refrigerant gas; from an inlet 22 which circulates through the spaces between the tubing 9 and to an outlet 26.

The cooling fluid (in a direction as indicated by W1) is circulated through the condenser tubing 9 from an inlet duct 1, which is connected to an upstream side of the condenser tubing 9 by the inlet pipe 6, to an outlet duct 16 connected to a downstream side of the tubing 9 by the outlet pipe 10.

The cleaning system comprises a plurality of cleaning elements and in this embodiment cleaning balls 12 are used. Such cleaning balls 12 are typically made from spongy material and have a diameter slightly larger than the diameter of the tubing 9 so that the balls 12 are compressed when they are forced through the tubing 9 to prevent the lodging or settling of particles within the tubing 9. In this way, unwanted deposits are prevented from building up in the tubing 9 which may lower the efficiency of the heat exchange, or even

cause corrosion.

The cleaning system further comprises a constriction which may be formed as part of the inlet pipe 6 or as a separate member connectable to the inlet pipe 6. In this embodiment, the constriction is formed using a constriction member 40 interposed between the inlet pipe 6 and the inlet duct 1 at the upstream side of the tubing 9. The constriction member 40 comprises two outer portions 2,4 which are tapered inwards and towards a centre portion 3 which is narrower than the two outer portions 2,4. An enlarged cross-sectional view of the constriction member 40 is shown in Figure 1a.

The cleaning system also comprises a separator 14 and recirculating means to transfer the cleaning balls 12 from the outlet pipe 10 to the inlet pipe 6.

The function of the separator 14 is to separate the cleaning balls 12 from the cooling fluid at the outlet pipe 10 and in this embodiment, the separator 14 has a shape of a funnel. The separator 14 is interposed between the outlet pipe 10 and the outlet duct 16 which releases the fluid. The separator 14 comprises perforations arranged to allow the fluid to pass through to the outlet duct 16 but not the cleaning balls 12.

Preferably, the perforations are in the form of rectangular slots 36 having a length direction inclined in a particular direction, for example anti-clockwise, as viewed in the fluid flow direction. Detailed views of the separator 14 according to this embodiment and the inclined slots 36 are shown in Figures 4 and 5,

respectively. The separator 14 includes a neck portion 15 connected to the recirculating means for transferring the cleaning balls 12 from the outlet pipe 10 to the inlet pipe 6.

In this embodiment, the recirculating means comprises a housing 50 for collecting the cleaning balls 12 and a ball return pipe 17 coupled to the neck 15 of the separator 14. The ball return pipe 17 may include a hand valve HV2 which is always open except when replacing or adding the cleaning balls 12. The housing 50 for collecting the cleaning balls 12 has an apertured partition 25 dividing the interior of the housing 50 into an upper compartment 19 and a lower compartment 24 on opposite sides of the partition 25. The partition 25 permits the fluid, but not the balls 12, to pass through so that the balls 12 accumulate within the upper compartment 19. The housing 50 may further include a cover 18 for covering the upper compartment 19 and which is removable therefrom in order to add or remove the cleaning balls 12.

The recirculating means further comprises a ball supply pipe 21, which is used to supply the cleaning balls 12 back to the tubing 9. The ball supply pipe 21 connects an outlet 20 on the upper compartment 19 to an inlet 3a (as shown in Figure 1a) on the centre portion 3 of the constriction member 40. A branch pipe 23 of the recirculating means is used to connect an outlet 23a on the lower compartment 24 to an inlet on the ball supply pipe 21 so that the fluid contained in the lower compartment 24 can be allowed to flow back to the inlet pipe 6. The ball supply pipe 21, which is used to supply the balls 12 back to the inlet pipe 6, may include a hand valve HV1 which is always open except when changing the

cleaning balls 12.

The housing 50 further comprises two valves VAL 1 and VAL 2 disposed along the ball supply and ball return pipes 21,23 for controlling the fluid flow from the downstream side of the condenser tubing 9 to the upstream side of the condenser tubing 9 via the housing 50. The first valve VAL 1 controls the outlet 20 of the upper compartment 19 and the second valve VAL 2 controls the outlet 23a of the lower compartment 24. The first valve VAL 1 is operative to transfer the cleaning balls 12 from the housing 50 to the inlet pipe 6 and the second valve VAL 2 is operative to transfer the cleaning balls 12 from the outlet pipe 10 or the separator 14 to the housing 50.

The cleaning system may further comprise rotation means arranged at the inlet pipe 6 and outlet pipe 10 and in this embodiment propellers are used.

A first propeller 5 is placed after the constriction member 40 and before the tubing 9 to rotate the cleaning balls 12 so that the balls 12 enter the tubing 9 in a random pattern, as indicated by reference numeral 7. A second propeller 11 is placed at the outlet pipe 10 and before the separator 14 so that the fluid and the balls 12 are rotated to let the balls 12 collide with each other at the mouth 13 of the separator 14.

Having described the various components of the cleaning system, an operation of the system will now be described with reference to Figures 1, 2 and 3.

We assume an initial position, which is illustrated in Figure 1, whereby the valves VAL 1 and VAL 2 are closed and the balls 12 are accumulated within the upper compartment 19 of the housing 50.

When the condenser 8 is operating, the cooling fluid is going through the inlet duct 1 with a velocity of, for example V1. The velocity V1 of flow increases when the fluid arrives at the first tapered portion 2 of the constriction member 40 and reaches the maximum velocity V3 at the centre portion 3 of the constriction member 40, which forms the constriction. According to a principle of fluid mechanics, the static pressure at the centre portion 3 of the constriction member 50 would be less than the static pressure at inlet duct 1. Similarly, the pressure at the centre portion 3 of the constriction member 50 would also be less than the static pressure at the neck portion 15 of separator 14 and at the outlet pipe 10. This difference in pressure creates a suction force to draw or suck the fluid (and the cleaning balls 12) from the outlet pipe 10 and into the housing 50 via the ball return pipe 17.

To allow the cleaning balls 12 to be drawn out to the inlet pipe 6, the first valve VAL 1 is opened with the second valve VAL 2 closed. The cleaning balls 12 are then sucked out from the housing 50 and into the inlet pipe 6 for circulating to the tubing 9 to clean the internal walls of the tubing 9. This is the condition illustrated in Figure 2.

After all the balls 12 are drawn into the inlet pipe 6 both valves VAL 1 and VAL 2 can then be closed for stopping the fluid flow into the ball return pipe 17 from

the outlet pipe 10. This facilitates the discharge of the dirt particles removed from the tubing 9, which will be described below.

The first propeller 5, at the time when the first valve VAL 1 is opened, is also activated to force the fluid flow W2 to rotate and also the cleaning balls 12 and as a result the balls 12 enter the tubing 9 randomly. After the cleaning process, the second propeller 11 again rotates the cleaning balls 12 so that the balls 12 collide with each other and the dirt particles, which were removed by the cleaning balls from tubing 9 and are now attached to the balls, are "rubbed" off. The dirt particles would then be carried by the fluid flow W3 for discharge though the outlet duct 16. It should be noted that the direction of rotation of the second propeller 11 and thus the balls 12 is preferably in the opposite direction when compared to the inclined slots 36 of the separator 14. For example, if the length direction of the inclined slots 36 is anti-clockwise, then the rotation of the balls 12 by the propeller 11 should, preferably, be clockwise. This would increase the collision of the balls with each other.

After the rotation, the balls 12 accumulate at the mouth 13 of the separator 14 since the two valves VAL 1 and 2 are closed, as illustrated in Figure 3.

To return the cleaning balls 12 to the housing 50, the second valve VAL 2 is opened (and the first valve VAL 1 remained closed), so that a difference in pressure draws the cleaning balls 12 through the neck portion 15 of the separator 14 and through the ball return pipe 17. Finally, the cleaning balls 12 arrive back at the upper compartment 19 of the housing 50. The cleaning balls

12 is prevented from flowing to the ball supply pipe 21 because the first valve VAL 1 is closed and thus the balls 12 accumulate within the upper compartment 19 of the housing 50 as illustrated in Figure 1.

When a need arises, when the balls 12 need to be replaced, the hand valves HV1 and HV2 are closed and the cover 18 is opened, so that the balls 12 can be replaced.

From the described embodiment, it can be observed that the operation of the whole cleaning system can easily be controlled via the two valves VAL 1 and VAL 2, which can be manually operated or means provided to operate them automatically. In addition, the system does not waste the cooling fluid which can easily be recirculated together with the cleaning balls 12.

While the invention has been described with respect to one preferred embodiment, it will be appreciated that this is set forth merely for purposes of example, and that many variations, modifications and applications of the invention may be made.

Claims

1. A system for cleaning tubing used for conducting a fluid therethrough, the tubing being connected to an inlet pipe and an outlet pipe, the system comprising

a plurality of cleaning elements for circulating with the fluid through the tubing;

a separator disposed at the outlet pipe and arranged to separate the cleaning elements from the fluid; and

recirculating means arranged to selectively transfer the plurality of cleaning elements from the outlet pipe to the inlet pipe,

wherein the inlet pipe includes a constriction having an inlet coupled to the recirculating means such that the pressure at the constriction of the inlet pipe is lower than that at the outlet pipe.

2. A cleaning system according to claim 1 wherein the recirculating means comprises

a housing arranged to collect the cleaning elements, the housing having a first and second compartment separated by an apertured partition, the partition arranged to allow the fluid to pass through to the second compartment but not the cleaning elements,

a ball return pipe coupling an inlet on the first compartment to an outlet of the separator,

a ball supply pipe coupled to an outlet on the first compartment, and

a branch pipe coupling an outlet on the second compartment to an inlet on the ball supply pipe.

3. A cleaning system according to claim 2, wherein the recirculating means further comprises a first valve disposed along the ball supply pipe, and a second valve disposed along the branch pipe; the first valve being operative to transfer the cleaning elements from the housing to the inlet pipe and the second valve being operative to transfer the cleaning elements from the outlet pipe to the housing.

4. A cleaning system according to claim 2 or claim 3, further comprising a third valve disposed along the ball return pipe.

5. A cleaning system according to any one of claims 2 to 4, wherein the housing further comprises a removable cover.

6. A cleaning system according to any one of the preceding claims, wherein the constriction is formed by two outer portions tapered towards a centre portion such that the centre portion is narrower than the two outer portions.

7. A cleaning system according to any one of the preceding claims, wherein the separator is in a shape of a funnel.

8. A cleaning system according to claim 7, wherein the separator

comprises perforations which allow the fluid to flow through but not the cleaning elements.

9. A cleaning system according to claim 8, wherein the perforations are in the form of rectangular slots each having a length direction.

10. A cleaning system according to claim 9, wherein the length directions of the rectangular slots are not parallel to the centre axis of the funnel.

11. A cleaning system according to any one of the preceding claims, further comprising means to rotate the fluid and the cleaning elements after the constriction at the inlet pipe.

12. A cleaning system according to any one of the preceding claims, further comprising means to rotate the fluid and the cleaning elements at the outlet pipe before the separator.

13. A cleaning system according to claim 9 or claim 10, and dependent on claim 12, wherein the direction of the rotational means is opposite to the length direction of the rectangular slots.

14. A cleaning system according to any one of the preceding claims, wherein the cleaning elements are balls.

ABSTRACT

A Cleaning System

A cleaning system for cleaning tubing using cleaning balls 12 circulated with the fluid through tubing 9. The system includes a separator 14 having a perforated funnel, which permits the fluid, but not the balls 12, to pass through. A housing 50 having an apertured partition 25 is used to divide the housing 50 into an upper 19 and a lower compartment 24. A constriction, formed by a constriction member 40, creates a difference in pressure to create a suction force to recirculate the balls 12 from the separator 14 via a ball return pipe 17, into the housing 50 and then back to the tubing 9 again for cleaning the walls of the tubing 9.

Figure 1

G00002

162162

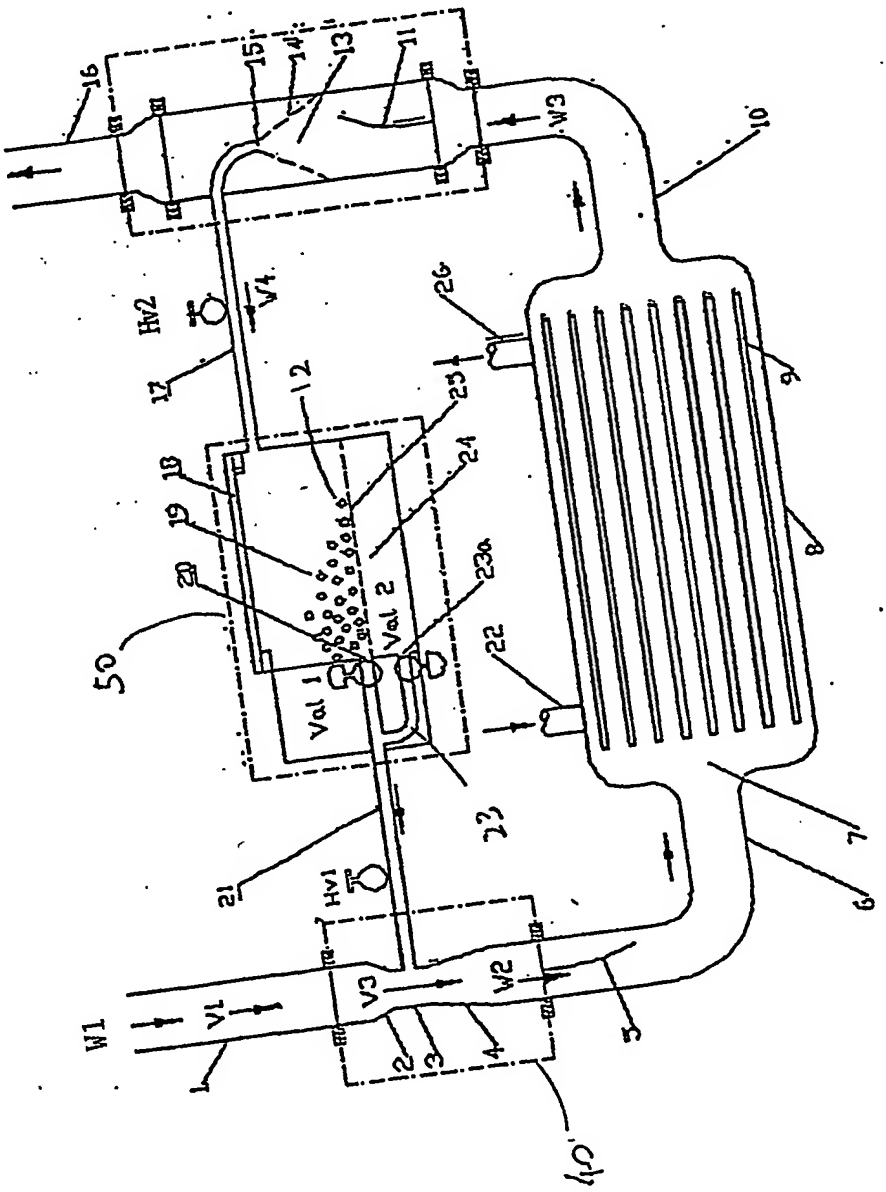
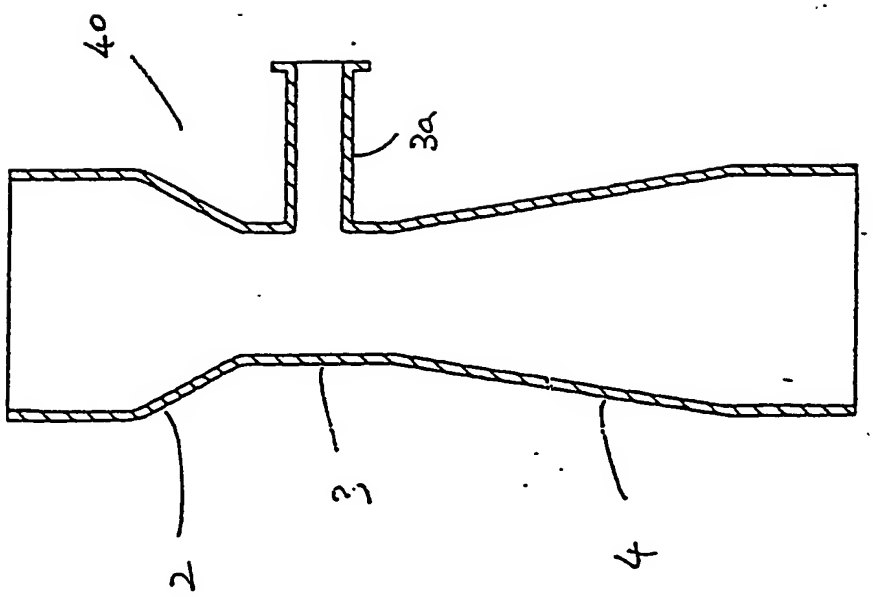


Figure 1

Figure 1a



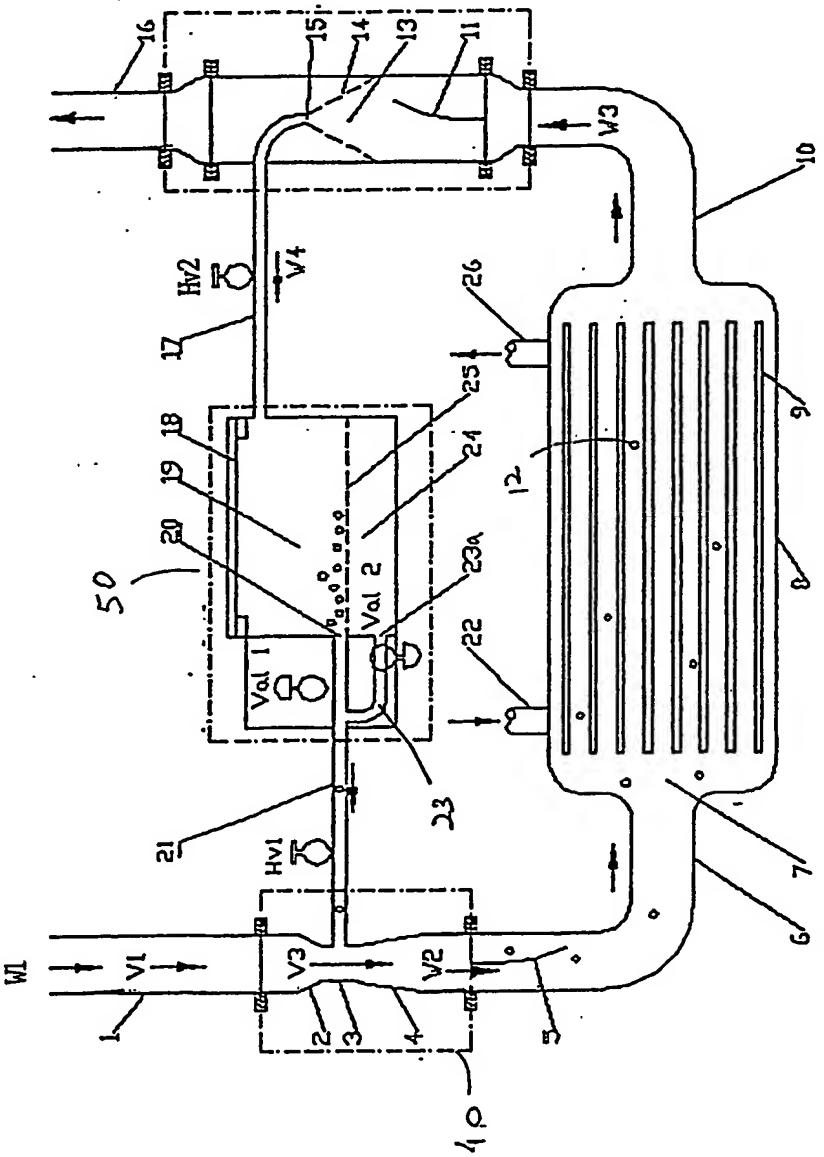

W1
V1
V3
V2
Hv1
Hv2
V4
V3
Val 1
Val 2
50
40
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
23A
24
25
26

Figure 2

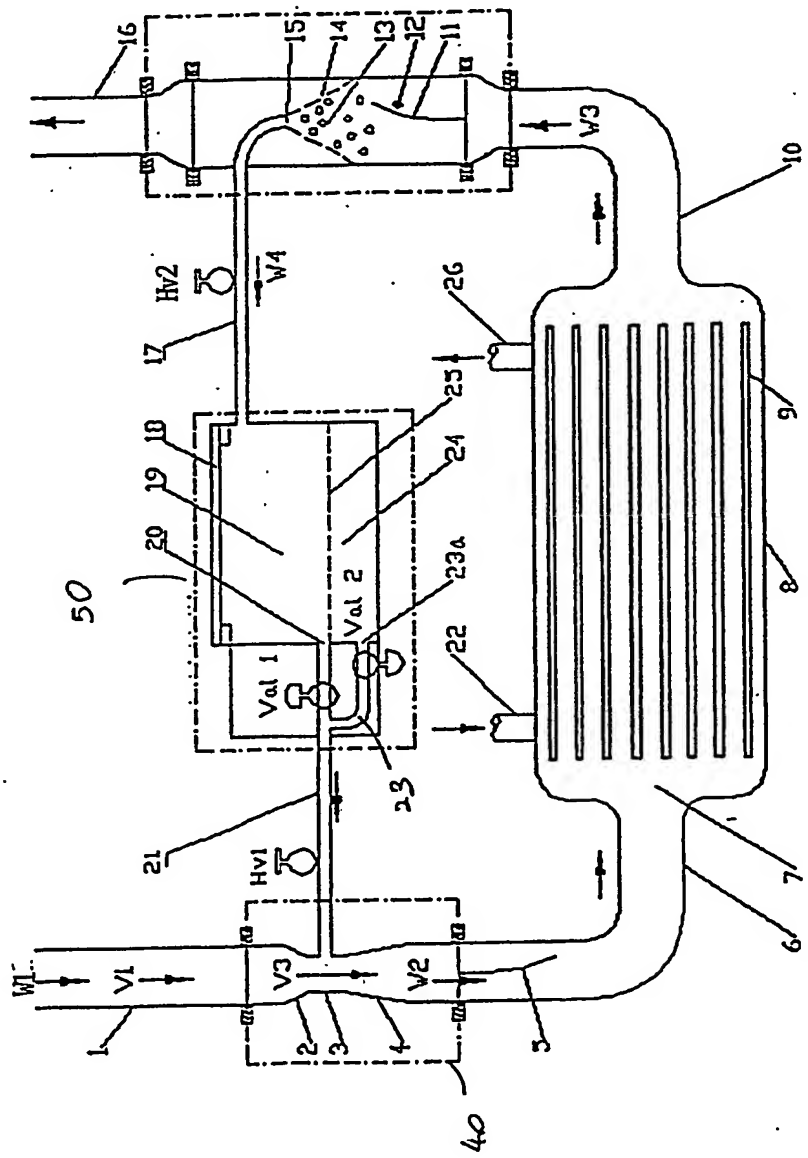

16
15
14
13
12
11
W3
10
Hv2
W4
17
26
25
9
18
19
24
20
50
Val 2
234
8
Val 1
22
23
21
Hv1
7
W1
V1
V3
V2
6
1
2
3
4
5
40

Figure 3

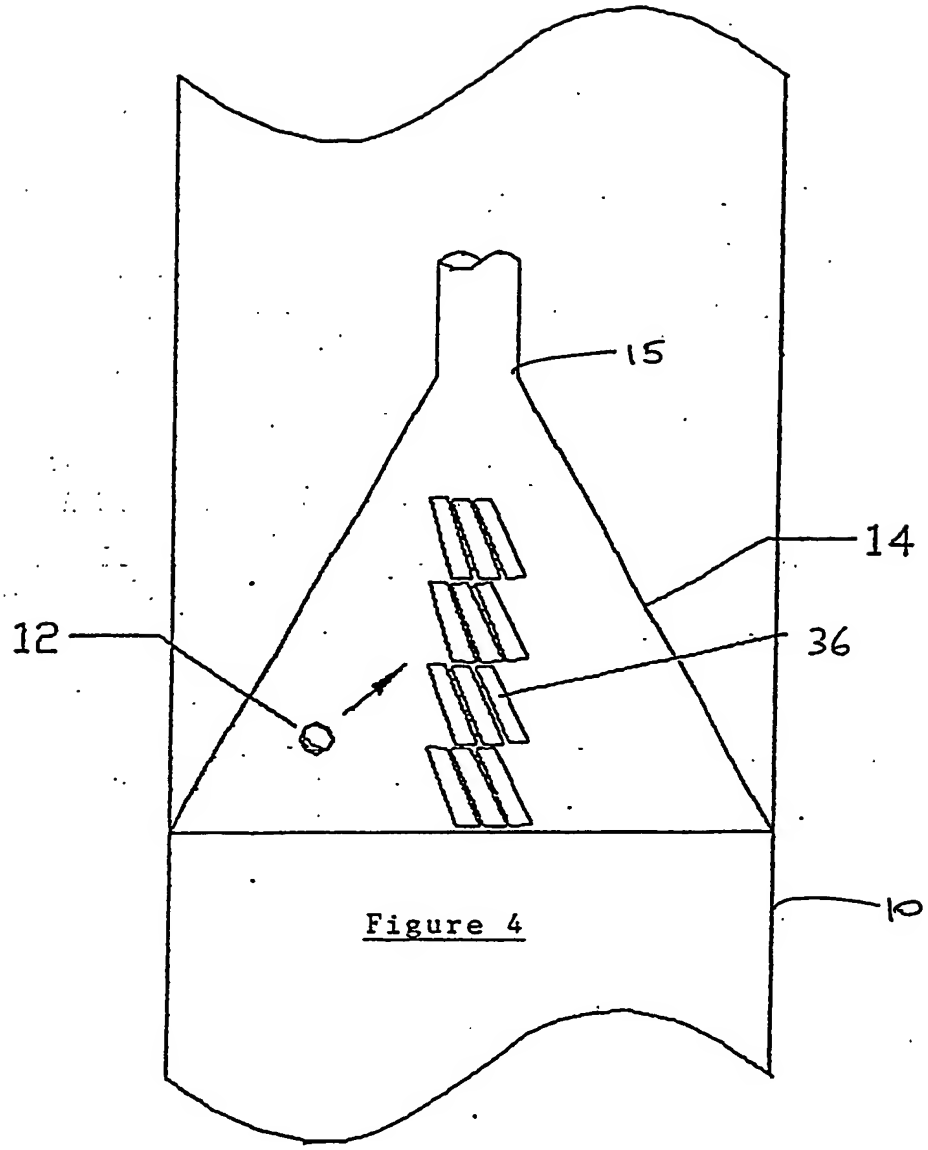


Figure 4

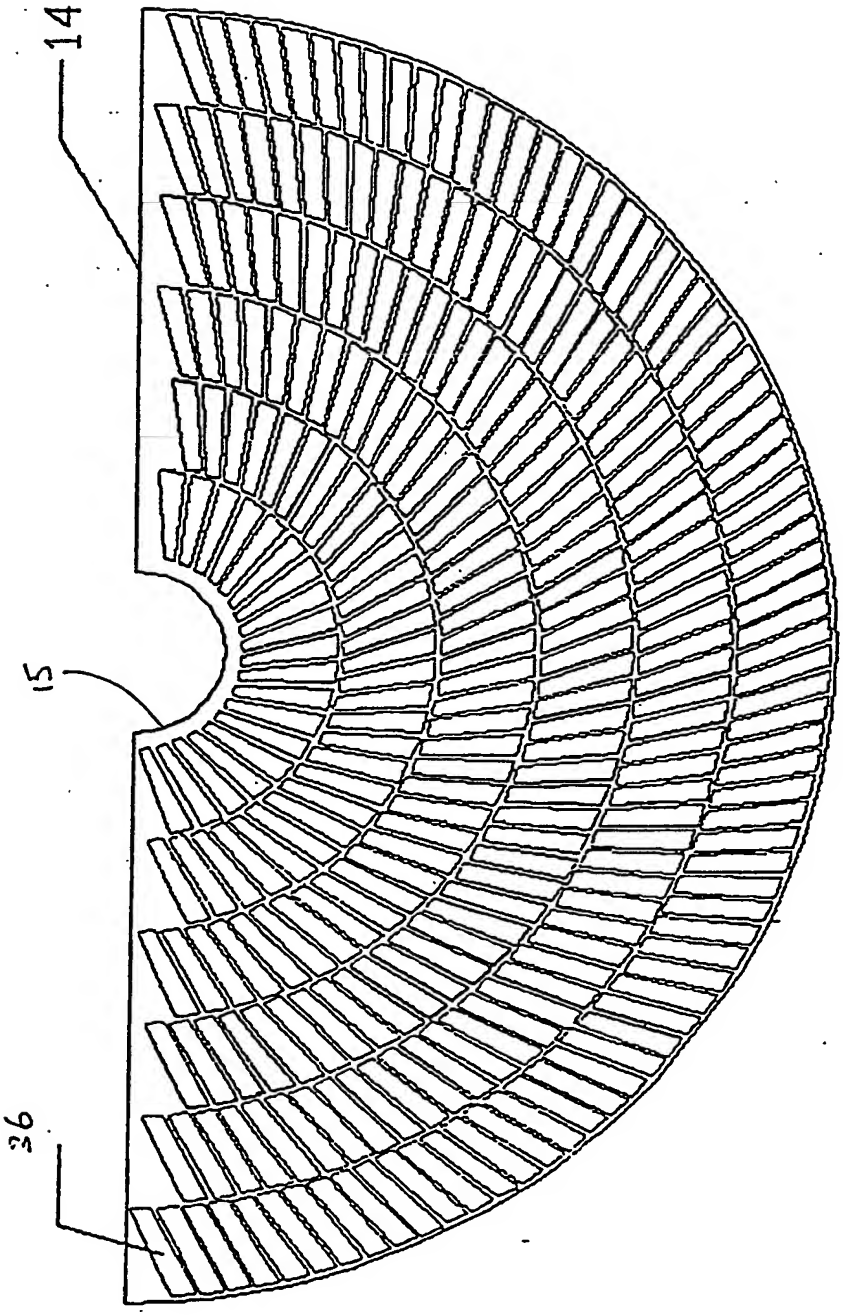


Figure 5